

# Penn Cambria Curriculum

<b>Course Name</b>	<b>Geometry</b>
<b>Length of Course</b>	1 credit course (1 semester in block schedule)
<b>Grade Level</b>	Generally grade 10
<b>Prerequisites</b>	Algebra 1
<b>Course Description</b>	High School geometry is a challenging course building on the strong conceptual foundation students develop in previous mathematical courses. Students should have opportunities to visualize and work with three-dimensional figures in order to develop spatial skills fundamental to everyday life and to many careers. The interplay between geometry and algebra strengthens students' ability to formulate and analyze problems from situations both within and outside mathematics.
<b>Units of Study</b>	Points, Lines, Planes and Angles Deductive Reasoning Parallel Lines and Planes Congruent Triangles Triangles, Circles, Pythagorean Theorem Similar Polygons Quadrilaterals Area and Volume
<b>Materials</b>	Text: Jurgansen, Ray. <u>Geometry</u> . McDougell Littell, 1994 and 2004. <u>Larson Geometry 1</u> c 2011 Holt McDougal Supplemental Materials: Geometer's Sketchpad

The additional 10 days are used to adjust for re-teaching, final review, final, and days lost due to 4Sights and PSSA testing.

**\*\* Standard Alignment** is based on PDE's revised draft standards provided on the Standards Aligned System. Keystone Assessment Anchor alignment is included at the end of the curriculum document.

## Unit: Points, Lines, Planes, and Angles

**Estimated Time:** 7-8 days

**Standard Alignment:** (based on PDE Revised Draft Standards dated Jan. 2010)

- 2.3.11.C Use properties of geometric figures and measurement formulas to solve for a missing quantity.
- 2.2.11.C Evaluate numerical expressions that include the four basic operations.
- 2.5.11.B Use symbols, mathematical terminology, standard notation, mathematical rules, graphing and other types of mathematical representations to communicate observations, predictions, concepts, procedures, generalizations, ideas, and results.
- 2.5.11.A Develop a plan to analyze a problem, identify the information needed to solve the problem, carry out the plan, check whether an answer makes sense, and explain how the problem was solved in grade appropriate contexts.
- 2.9.11.A Identify and use properties and relations of geometric figures; create justifications for arguments related to geometric relations.

## **Curricular Objectives:**

Students will:

- a. Define and use the following terms correctly: equidistant, point, line, plane, collinear, coplanar, intersection, segment, ray, opposite rays, congruent, midpoint, and bisector of segments.
- b. Apply the following terms in problem solving situations (two and three dimensions): equidistant, point, line, plane, collinear, coplanar, intersection, segment, ray, opposite rays, congruent, midpoint, and bisector of segments.
- c. Find the distance between two points on a number line.
- d. State and use the ruler postulate and segment addition postulate in problem solving situations.
- e. Review the steps needed to solve linear equations.
- f. Define and use the following terms correctly: angles, vertex, acute, obtuse, right, adjacent angles, angle bisector.
- g. Apply the following terms in problem solving situations (two and three dimensional): angles, vertex, acute, obtuse, right, adjacent angles, angle bisector.
- h. State and use the protractor postulate and the angle addition postulate in problem solving situations.
- i. State and use postulates and theorems relating points, lines, and planes.
- j. Use a protractor to measure angles.

## **Assessments/ Measurement of Objectives:**

- Book exercises
- Supplemental worksheets
- Class and/or homework Activities
- Objective quizzes and tests
- Geometer's sketchpad exercises

## **Suggested Methods of Instruction / Learning Activities:**

- ✓ Direct instruction
- ✓ Computer software

**Estimated Time:** 12-13 days

**Standard Alignment:** (based on PDE Revised Draft Standards dated Jan. 2010)

- 2.3.11.C Use properties of geometric figures and measurement formulas to solve for a missing quantity.
- 2.2.11.C Evaluate numerical expressions that include the four basic operations.
- 2.4.11.B Use statements, converses, inverses and contra-positives to construct valid arguments or to validate arguments relating to geometric theorems.
- 2.4.11.A write formal proofs (direct proofs, indirect proofs/proofs by contradiction, use of counter-examples, truth tables, etc.) to validate conjectures or arguments.
- 2.5.11.B Use symbols, mathematical terminology, standard notation, mathematical rules, graphing and other types of mathematical representations to communicate observations, predictions, concepts, procedures, generalizations, ideas, and results.
- 2.5.11.A Develop a plan to analyze a problem, identify the information needed to solve the problem, carry out the plan, check whether an answer makes sense, and explain how the problem was solved in grade appropriate contexts.
- 2.9.11.A Identify and use properties and relations of geometric figures; create justifications for arguments related to geometric relations.
- 2.8.11.C Recognize, describe, and generalize patterns, using sequences and series to predict long-term outcomes.

### **Curricular Objectives:**

Students will:

- a. Use conditional statements to write a converse, write counterexamples to disprove a statement, and write bi-conditionals.
- b. State and use the properties from algebra in problem-solving situations.
- c. State and use the midpoint theorem and the angle bisector theorem in problem solving situations.
- d. Use properties from algebra, the midpoint theorem and the angle bisector theorem along with other postulates and theorems to complete the reasons in proofs.
- e. Use a protractor to measure angles.
- f. Use the terms complementary angles, supplementary angles, and perpendicular lines in problem solving situations.
- g. Use the theorem, vertical angles are congruent, in problem solving situations.
- h. Use the theorems relating to perpendicular lines in problem solving situations.
- i. Use terms related to angles and perpendicular lines, postulates, and theorems to complete the reasons in proofs.
- j. Construct an angle; construct an equilateral triangle using the radii of two overlapping congruent triangles and construct vertical angles.

### **Assessments/ Measurement of Objectives:**

- Book exercises
- Supplemental worksheets
- Class and/or homework Activities
- Objective quizzes and tests
- Geometer's sketchpad exercises

### **Suggested Methods of Instruction / Learning Activities:**

- ✓ Direct instruction
- ✓ Computer software

<b>Unit: Parallel Lines and Planes</b>
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**Estimated Time:** 14-15 days

**Standard Alignment:** (based on PDE Revised Draft Standards dated Jan. 2010)

2.2.11.C Evaluate numerical expressions that include the four basic operations.

2.4.11.B Use statements, converses, inverses and contra-positives to construct valid arguments or to validate arguments relating to geometric theorems.

2.4.11.A write formal proofs (direct proofs, indirect proofs/proofs by contradiction, use of counter-examples, truth tables, etc.) to validate conjectures or arguments.

2.5.11.B Use symbols, mathematical terminology, standard notation, mathematical rules, graphing and other types of mathematical representations to communicate observations, predictions, concepts, procedures, generalizations, ideas, and results.

2.5.11.A Develop a plan to analyze a problem, identify the information needed to solve the problem, carry out the plan, check whether an answer makes sense, and explain how the problem was solved in grade appropriate contexts.

2.9.11.A Identify and use properties and relations of geometric figures; create justifications for arguments related to geometric relations.

### **Curricular Objectives:**

Students will:

- a. Use the terms: parallel, skew, and intersecting
- b. Identify the angles formed when two lines are cut by a transversal
- c. Use all of the unit related definitions, postulates, and theorems to state the reasons in proofs
- d. Use the properties of angles formed when two parallel lines are cut by a transversal to find the measures of missing angles.
- e. Classify triangles according to sides and to angles
- f. State and use the theorems about the sum of the measures of the exterior and interior angles of a triangle
- g. Differentiate between convex and non-convex polygons
- h. Use the diagonals of a convex polygon to find the sum of the interior angles in a polygon
- i. State and apply the theorems involving the sum of the exterior and the interior angles in a convex polygon.
- j. Construct and calculate the exterior angles in a polygon, construct and calculate the interior angle measure sums, construct regular polygons
- k. Differentiate between inductive and deductive reasoning
- l. Use inductive reasoning to predict the next numbers in a sequence
- m. Use properties of angles formed by intersecting lines to find the measures of missing angles.

### **Assessments/ Measurement of Objectives:**

- Book exercises
- Supplemental worksheets
- Class and/or homework Activities
- Objective quizzes and tests
- Geometer's sketchpad or other technology related exercises

### **Suggested Methods of Instruction / Learning Activities:**

- ✓ Direct instruction
- ✓ Computer software

<b>Unit: Congruent Triangles</b>
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**Estimated Time:** 10-12 days

**Standard Alignment:** (based on PDE Revised Draft Standards dated Jan. 2010)

- 2.4.11.B Use statements , converses, inverses and contra-positives to construct valid arguments or to validate arguments relating to geometric theorems.
- 2.4.11.A write formal proofs (direct proofs, indirect proofs/proofs by contradiction, use of counter-examples, truth tables, etc.) to validate conjectures or arguments.
- 2.5.11.B Use symbols, mathematical terminology, standard notation, mathematical rules, graphing and other types of mathematical representations to communicate observations, predictions, concepts, procedures, generalizations, ideas, and results.
- 2.5.11.A Develop a plan to analyze a problem, identify the information needed to solve the problem, carry out the plan, check whether an answer makes sense, and explain how the problem was solved in grade appropriate contexts.
- 2.9.11.A Identify and use properties and relations of geometric figures; create justifications for arguments related to geometric relations.
- 2.9.11.B Use arguments based on transformations to establish congruence or similarity of 2-dimensional shapes.

**Curricular Objectives:**

Students will:

- a. Identify the corresponding parts of congruent triangles
- b. Prove two triangles are congruent by using the SSS postulate, SAS postulate, ASA postulate, AAS theorem, and HL theorem
- c. Deduce information about segments and angles after proving that two triangles are congruent
- d. Plot points on a coordinate plane and name congruent triangles
- e. State and apply the theorems about isosceles triangles

**Assessments/ Measurement of Objectives:**

- Book exercises
- Supplemental worksheets
- Class and/or homework Activities
- Objective quizzes and tests
- Geometer's sketchpad or other technology related exercises

**Suggested Methods of Instruction / Learning Activities:**

- ✓ Direct instruction
- ✓ Computer software

<b>Unit: Triangles, Circles, Pythagorean Theorem</b>
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**Estimated Time:** 13-14 days

**Standard Alignment:** (based on PDE Revised Draft Standards dated Jan. 2010)

- 2.1.11.A Model and compare values of irrational numbers.
- 2.3.11.C Use properties of geometric figures and measurement formulas to solve for a missing quantity.
- 2.2.11.C Evaluate numerical expressions that include the four basic operations.
- 2.5.11.B Use symbols, mathematical terminology, standard notation, mathematical rules, graphing and other types of mathematical representations to communicate observations, predictions, concepts, procedures, generalizations, ideas, and results.
- 2.5.11.A Develop a plan to analyze a problem, identify the information needed to solve the problem, carry out the plan, check whether an answer makes sense, and explain how the problem was solved in grade appropriate contexts.
- 2.9.11.A Identify and use properties and relations of geometric figures; create justifications for arguments related to geometric relations.
- 2.10.11.A Identify, create, and solve practical problems involving right triangles using the trigonometric functions and the Pythagorean theorem.
- 2.8.11.F Interpret the results of solving equation, inequalities, systems of equations, and inequalities in the context of the situation that motivated the model.

**Curricular Objectives:**

Students will:

- a. Apply properties of inequality to positive numbers, lengths of segments, and measures of angles.
- b. Identify the medians, altitude, and perpendicular bisectors of triangles.
- c. Use median, altitude and perpendicular bisector to problem solve.
- d. Construct the appropriate altitudes, medians, angle bisectors, and perpendicular bisectors to form circumcenters, in-centers, and centroid points.
- e. Identify, determine and use the radius, diameter, segment and/or tangent of a circle.
- f. Identify, determine and use the arcs, semicircles, sectors, and/or angles of a circle.
- g. Use chords, tangents, and secants to find missing arc measures or missing segment measures.
- h. State and apply the Pythagorean theorem.
- i. State and apply the converse of the Pythagorean theorem and related theorems about obtuse and acute triangles.
- j. Simplify a radical expression.

**Assessments/ Measurement of Objectives:**

- Book exercises
- Supplemental worksheets
- Class and/or homework Activities
- Objective quizzes and tests
- Geometer's sketchpad or other technology related exercises

**Suggested Methods of Instruction / Learning Activities:**

- ✓ Direct instruction
- ✓ Computer software

<b>Unit: Similar Polygons</b>
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**Estimated Time:** 5-7 days

**Standard Alignment:** (based on PDE Revised Draft Standards dated Jan. 2010)

- 2.1.G.C Use ratio and proportion to model relationships between quantities.
- 2.3.11.C Use properties of geometric figures and measurement formulas to solve for a missing quantity.
- 2.2.11.C Evaluate numerical expressions that include the four basic operations.
- 2.4.11.B Use statements , converses, inverses and contra-positives to construct valid arguments or to validate arguments relating to geometric theorems.
- 2.5.11.B Use symbols, mathematical terminology, standard notation, mathematical rules, graphing and other types of mathematical representations to communicate observations, predictions, concepts, procedures, generalizations, ideas, and results.
- 2.9.11.A Identify and use properties and relations of geometric figures; create justifications for arguments related to geometric relations.
- 2.9.11.B Use arguments based on transformations to establish congruence or similarity of 2-dimensional shapes.

### **Curricular Objectives:**

Students will:

- a. Express a ratio in simplest form.
- b. Solve for an unknown term in a given proportion.
- c. Express a given proportion in an equivalent form.
- d. State and apply the properties of similar polygons.
- e. Use the AA similarity postulate, the SAS Similarity theorem, and the SSS Similarity theorem to prove triangles similar.
- f. Use similar triangles to deduce information about segments or angles.
- g. Apply the Triangle Proportionality Theorem and its corollary.
- h. State and apply the Triangle Angle-Bisector Theorem.
- i. Determine the geometric mean between two numbers.
- j. State and apply the relationships that exist when the altitude is drawn to the hypotenuse of a right triangle

### **Assessments/ Measurement of Objectives:**

- Book exercises
- Supplemental worksheets
- Class and/or homework Activities
- Objective quizzes and tests
- Geometer's sketchpad or other technology related exercises

### **Suggested Methods of Instruction / Learning Activities:**

- ✓ Direct instruction
- ✓ Computer software

<b>Unit: Quadrilaterals</b>
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**Estimated Time:** 9-11 days

**Standard Alignment:** (based on PDE Revised Draft Standards dated Jan. 2010)

- 2.3.11.C Use properties of geometric figures and measurement formulas to solve for a missing quantity.

- 2.2.11.C Evaluate numerical expressions that include the four basic operations.
- 2.4.11.B Use statements , converses, inverses and contra-positives to construct valid arguments or to validate arguments relating to geometric theorems.
- 2.5.11.B Use symbols, mathematical terminology, standard notation, mathematical rules, graphing and other types of mathematical representations to communicate observations, predictions, concepts, procedures, generalizations, ideas, and results.
- 2.9.11.A Identify and use properties and relations of geometric figures; create justifications for arguments related to geometric relations.
- 2.9.11.B Use arguments based on transformations to establish congruence or similarity of 2-dimensional shapes.

### **Curricular Objectives:**

Students will:

- a. Apply the definition of a parallelogram, and the theorems about properties of parallelograms.
- b. Prove that certain quadrilaterals are parallelograms.
- c. Apply theorems about parallel lines and the segment that joins the midpoints of two sides of a triangle.
- d. Apply the definitions and identify the special properties of a rectangle, a rhombus, and a square.
- e. Determine when a parallelogram is a rectangle, rhombus, or a square.
- f. Apply the definitions and identify the properties of a trapezoid and an isosceles trapezoid.

### **Assessments/ Measurement of Objectives:**

- Book exercises
- Supplemental worksheets
- Class and/or homework Activities
- Objective quizzes and tests
- Geometer's sketchpad or other technology related exercises

### **Suggested Methods of Instruction / Learning Activities:**

- ✓ Direct instruction
- ✓ Computer software
- ✓ Create a graphic organizer to represent polygon terms

<b>Unit: Area and Volume</b>
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**Estimated Time:** 12-15 days

**Standard Alignment:** (based on PDE Revised Draft Standards dated Jan. 2010)

- 2.3.11.C Use properties of geometric figures and measurement formulas to solve for a missing quantity.
- 2.3.11.E Describe how a change in the value of one variable in a formula affects the value of the measurement.
- 2.2.11.C Evaluate numerical expressions that include the four basic operations.



- 2.5.11.A Develop a plan to analyze a problem, identify the information needed to solve the problem, carry out the plan, check whether an answer makes sense, and explain how the problem was solved in grade appropriate contexts.
- 2.9.11.A Identify and use properties and relations of geometric figures; create justifications for arguments related to geometric relations.
- 2.9.11.B Use arguments based on transformations to establish congruence or similarity of 2-dimensional shapes.
- 2.10.11.A Identify, create, and solve practical problems involving right triangles using the trigonometric functions and the Pythagorean theorem.
- 2.11.G.A Find the measures of the sides of a polygon with a given perimeter that will maximize the area of the polygon.
- 2.11.G.C Use sums of areas of standard shapes to estimate the areas of complex shapes.
- 2.8.11.F Interpret the results of solving equation, inequalities, systems of equations, and inequalities in the context of the situation that motivated the model.

### **Curricular Objectives:**

Students will:

- Understand what is meant about perimeter and area of a polygon
- Know and use the formulas for perimeter and area of rectangles, parallelograms, triangles, trapezoids, circles
- Estimate area, perimeter, and the circumference of an irregular figure
- Describe how a change in the linear dimension of a figure affects its perimeter, circumference, and area (ex: How does changing the length of the radius of a circle affect the circumference?)
- Identify the parts of prisms, cylinders, pyramids, and cones
- Find the surface area and volume of right prisms, regular pyramids, right cylinders, and right cones, and irregular solids
- Find the measurement of a missing length, given the surface area and volume
- Identify how a change in the linear dimension of a figure affects its surface area or volume (ex: How does changing the length of a cube affect the volume of the cube?)
- Find the area of a sector of a circle
- Identify and use the properties of a sphere or cylinder.

### **Assessments/ Measurement of Objectives:**

- Book exercises
- Supplemental worksheets
- Class and/or homework Activities
- Objective quizzes and tests
- Geometer's sketchpad or other technology related exercises

### **Suggested Methods of Instruction / Learning Activities:**

- ✓ Direct instruction
- ✓ Computer software

<b>Keystone Assessment Anchor Alignment - Geometry</b>
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#### **UNIT 1- POINTS, LINES, PLANES AND ANGLES**

##### **Keystone Alignment:**

G.2.1.2.1 Calculate the distance and/or midpoint between two points on a number line or on a coordinate plane

#### **UNIT 2 – DEDUCTIVE REASONING**

**Keystone Alignment:**

G.1.3.2.1 Write, analyze, complete, or identify formal proofs (e.g., direct and/or indirect proofs/proofs by contradiction)

**UNIT 3 – PARALLEL LINES AND PLANES****Keystone Alignment:**

G.1.3.2.1 Write, analyze, complete, or identify formal proofs (e.g., direct and/or indirect proofs/proofs by contradiction)

G.2.2.1.2 Use properties of angles formed when two parallel lines are cut by a transversal to find the measures of missing angles.

G.2.2.1.1 Use properties of angles formed by intersecting lines to find the measures of missing angles.

G.1.2.1.1 Identify and/or use properties of triangles.

G.1.2.1.3 Identify and/or use properties of isosceles and equilateral triangles.

G.1.2.1.4 Identify and/or use properties of regular polygons.

**UNIT 4 – CONGRUENT TRIANGLES****Keystone Alignment:**

G.1.3.1.1 Identify and/or use properties of congruent and similar polygons or solids.

G.1.3.2.1 Write, analyze, complete, or identify formal proofs (e.g., direct and/or indirect proofs/proofs by contradiction)

G.1.2.1.1 Identify and/or use properties of triangles.

G.1.2.1.3 Identify and/or use properties of isosceles and equilateral triangles.

G.1.2.1.4 Identify and/or use properties of regular polygons.

**UNIT 5 – TRIANGLES, CIRCLES, PYTHAGOREAN THEOREM****Keystone Alignment:**

G.2.1.1.1 Use the Pythagorean theorem to write and/or solve problems involving right triangles.

G.1.2.1.1 Identify and/or use properties of triangles.

G.1.2.1.2 Identify and/or use properties of quadrilaterals.

G.1.2.1.3 Identify and/or use properties of isosceles and equilateral triangles.

G.1.1.1.1 Identify, determine, and/or use the radius, diameter, segment and/or tangent of a circle.

G.1.1.1.2 Identify, determine, and/or use the arcs, semicircles, sectors, and/or angles of a circle.

G.1.1.1.3 Use chords, tangents, and secants to find missing arc measures or missing segment measures.

G.1.1.1.4 Identify and/or use the properties of a sphere or cylinder.

**UNIT 6 – SIMILAR POLYGONS****Keystone Alignment:**

G.1.3.1.1 Identify and/or use properties of congruent and similar polygons or solids.

G.1.3.1.2 Identify and/or use proportional relationships in similar figures.

G.2.2.1.1 Use properties of angles formed by intersecting lines to find the measures of missing angles.

G.1.2.1.1 Identify and/or use properties of triangles.

G.1.2.1.3 Identify and/or use properties of isosceles and equilateral triangles.

G.1.2.1.4 Identify and/or use properties of regular polygons.

**UNIT 7 – QUADRILATERALS****Keystone Alignment:**

G.2.2.1.1 Use properties of angles formed by intersecting lines to find the measures of missing angles.

G.1.2.1.1 Identify and/or use properties of triangles.

G.1.2.1.2 Identify and/or use properties of quadrilaterals.

G.1.2.1.3 Identify and/or use properties of isosceles and equilateral triangles.

G.1.2.1.4 Identify and/or use properties of regular polygons.

**UNIT 8 – AREA AND VOLUME****Keystone Alignment:**

G.2.1.1.1 Use the Pythagorean theorem to write and/or solve problems involving right triangles.

G.2.2.2.1 Estimate area, perimeter, or circumference of an irregular figure.

G.2.2.2.2 Find the measurement of a missing length, given the perimeter, circumference, or area.

G.2.2.2.3 Find the side lengths of a polygon with a given perimeter to maximize the area of the polygon.

- G.2.2.2.4 Develop and/or use strategies to estimate the area of a compound/composite figure.
- G.2.2.2.5 Find the area of a sector of a circle.
- G.2.2.3.1 Describe how a change in the linear dimension of a figure affects its perimeter, circumference, and area (e.g., How does changing the length of the radius of a circle affect the circumference of the circle?)
- G.2.2.4.1 Use area models to find probabilities.
- G.2.3.1.1 Calculate the surface area of prisms, cylinders, cones, pyramids, and/or spheres. Formulas are provided on a reference sheet.
- G.2.3.1.2 Calculate the volume of prisms, cylinders, cones, pyramids, and/or spheres. Formulas are provided on a reference sheet.
- G.2.3.1.3 Find the measurement of a missing length, given the surface area or volume.
- G.2.3.2.1 describe how a change in the linear dimension of a figure affects its surface area or volume (e.g., How does changing the length of the edge of a cube affect the volume of the cube?)
- G.2.2.1.1 Use properties of angles formed by intersecting lines to find the measures of missing angles.
- G.1.2.1.1 Identify and/or use properties of triangles.
- G.1.2.1.2 Identify and/or use properties of quadrilaterals.
- G.1.2.1.3 Identify and/or use properties of isosceles and equilateral triangles.
- G.1.2.1.4 Identify and/or use properties of regular polygons.
- G.1.2.1.5 Identify and/or use properties of pyramids and prisms.
- G.1.1.1.1 Identify, determine, and/or use the radius, diameter, segment and/or tangent of a circle.
- G.1.1.1.2 Identify, determine, and/or use the arcs, semicircles, sectors, and/or angles of a circle.
- G.1.1.1.4 Identify and/or use the properties of a sphere or cylinder.

### **KEYSTONE GEOMETRY Assessment Anchors That Still Need To Be Integrated**

Changes and adjustments to curriculum to include these anchors will be necessary as PDE provides updated information and guidance regarding Keystone Assessments and the PA Common Core Standards. However, given current changes and resulting transitions in math curriculum, this document reflects the current curriculum

#### **Keystone Alignment:**

- G.2.1.1.2 Use **trigonometric ratios** to write and/or solve problems involving right triangles.
- G.2.1.2.1 Calculate the distance and/or midpoint between two points on a number line or on a **coordinate plane**
- G.2.1.2.2 **Relate slope to perpendicularity and/or parallelism** (limit to linear algebraic equations).
- G.2.1.2.3 **Use slope**, distance, and/or midpoint between two points on a **coordinate plane** to establish properties of a 2-dimensional shape.
- G.2.1.3.1 **Apply the concept of the slope of a line to solve problems.**
- G.2.1.4.1 **Solve or graph systems of equations or systems of inequalities within a problem situation using coordinate geometry.**
- G.2.2.4.1 Use area models to find **probabilities**.